APPENDIX

The following code listing shows one implementation of the conventional VSCALE routine in accordance with ITU (International Telecommunication Union)-T Recommendation G.728 – Annex G.

```
;search for maximum positive and negative values in vector
                        movs.w @r4+,y0
      pcopy y0,y1.      movx.w @r4+,x1
      pcmp x1,y0
  dct pcopy x1,y0
      pcmp x1,y1
  dcf pcopy x1,y1       movx.w @r4+,x1
      pcmp x1,y0
  dct pcopy x1,y0
      pcmp x1,y1
  dcf pcopy x1,y1       movx.w @r4+,x1
      pcmp x1,y0
  dct pcopy x1,y0
      pcmp x1,y1
  dcf pcopy x1,y1       movx.w @r4,x1
      pcmp x1,y0        movx.w @r4+r8,x0
  dct pcopy x1,y0       movx.w @r4+r8,x0
      pcmp x1,y1        movx.w @r4+r8,x0
  dcf pcopy x1,y1       movx.w @r4+r8,x0

      sts   y0,r1
mov   r1,r0
      sts   y1,r7
      or    r7,r0
      tst   r0,r0
      bt    VS_ZERO

      pabs  y1,y1
      pclr  a0
      pinc  a0,a0
      lds   r6,y0
      psha  #16,y0
      psha  a0,y0,a0

      sts   y1,r0
      cmp/ge      r0,r1
      bt/s  vs_pos
      mov   #0,r0

      sts   a0, r3
      neg   r3,r3
      mov   r3,r2
      shll  r2
      cmp/ge      r2,r7
      bf    vsloop3

      cmp/gt      r7,r3
      bt    vs_end2

;Case 3: maximum negative value still has room for normalization
      .align      4
vsloop41:
      shal  r7
      cmp/gt      r7,r3
      bf/s  vsloop41
      add #1,r0
      lds   r0,y0
psha #16,y0
      movs.w @r4+,x1
      psha  x1,y0,a0    movx.w @r4+,x1
psha  x1,y0,a1    movx.w @r4+,x1
                        movs.w a0,@r5+
                        movx.w a1,@r5+
      psha  x1,y0,a0    movx.w @r4+,x1
psha  x1,y0,a1    movx.w @r4+,x1
                        movx.w a0,@r5+
      psha  x1,y0,a0
movx.w a1,@r5+
                        movx.w a0,@r5+

      rts
      nop

;Case 2: maximum negative value exceeds minimum range vsloop3:
      cmp/ge      r2,r7
      bt    vs_end2
      .align      4
vsloop31:
      shar  r7
      cmp/ge      r2,r7
bf/s  vsloop31
      add   #—1,r0

      lds   r0,y0
      psha  #16,y0
      movs.w @r4+,x1
      psha  x1,y0,a0    movx.w @r4+,x1
      psha  x1,y0,a1    movx.w @r4+,x1
                        movs.w a0,@r5+
                        movx.w a1,@r5+
      psha  x1,y0,a0    movx.w @r4+,x1
      psha  x1,y0,a1    movx.w @r4+,x1
                        movx.w a0,@r5+
      psha x1,y0,a0
                        movx.w a1,@r5+
                        movx.w a0,@r5+

      rts
      nop

;Case 1: zero input vector
VS_ZERO:
      pclr a0
                        movs.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
      mov r6,r0
      add #1,r0

      rts
      nop

      .align      4
vs_pos:
      sts   a0,r2
      mov   r2,r3
add   #—1,r3
      add   r2,r3

cmp/ge      r1,r3
      bf    vsloop5

cmp/ge      r2,r1
      bt    vs_end2

;Case 5: maximum positive value still has room for normalization
      .align      4
vsloop61:
      shal  r1
      cmp/ge      r2,r1
      bf/s  vsloop61
      add #1,r0
vs_end2:
      lds   r0,y0
      psha  #16,y0
      movs.w @r4+,x1
      psha  x1,y0,a0    movx.w @r4+,x1
      psha  x1,y0,a1    movx.w @r4+,x1
                        movs.w a0,@r5+
                        movx.w a1,@r5+
      psha  x1,y0,a0    movx.w @r4+,x1
      psha  x1,y0,a1    movx.w @r4+,x1
                        movx.w a0,@r5+
      psha  x1,y0,a0
                        movx.w a1,@r5+
                        movx.w a0,@r5+

      rts
      nop

;Case 4: maximum positive value exceeds maximum range
vsloop5
      cmp/ge      r1,r3
      bt    vs_end2

      .align      4
vsloop5:
      shar  r1
      cmp/ge      r1,r3
      bf/s  vsloop51
      add   #-1,r0

      bra   vs_end2
      nop
```

The following is an algorithm in accordance with a first embodiment of the present invention.

```
;search for minimum NLS
                        movs.w @r4+,x0
      pdmsb x0,a0       movx.w @r4+,x0
      pdmsb x0,y0
      pcmp a0,y0
  dct pcopy y0,a0       movx.w @r4+,x0
```

```
      pdmsb x0,y0
      pcmp a0,y0
  dct pcopy y0,a0       movx.w @r4+,x0
      pdmsb x0,y0
      pcmp a0,y0
  dct       pcopy y0,a0       movx.w @r4,x0
      pdmsb x0,y0       movx.w @r4+r8,x1;dummy movx to reset r4=&IN[0]
      pcmp a0,y0        movx.w @r4+r8,x1
  dct pcopy y0,a0       movx.w @r4+r8,x1
      psha #-16,a0      movx.w @r4+r8,x1

      sts   a0, r0            ;r0=NLS_MIN

;Case 1: zero input vector
      cmp/eq     #31, r0
      bf/s  VSCALE1_check_NLSeq31_end
      mov   r6, r7      ;r6=MLS

      mov   r6, r0
      add   #1, r0            ;set r0=NLS = MLS + 1
      pclr a0
                        movs.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
                        movx.w a0,@r5+
      rts
      nop

;Case 2: non-zero input vector
VSCALE1_check_NLSeq31_end:
      add   #-14, r7    ;r7=MLS-14
      add   r7, r0      ;r0=NLS = NLSmin + (MLS-14)
      lds   r0, y0

psha #16,y0
                        movs.w @r4+,x0
      psha x0,y0,a0     movx.w @r4+,x1
      psha x1,y0,a1     movx.w @r4+,x0
                        movs.w a0,@r5+
      psha  x0,y0,a0    movx.w a1,@r5+
                        movx.w a0,@r5+
                        movx.w @r4+,x1
      psha  x1,y0,a1    movx.w @r4+,x0
      psha  x0,y0,a0    movx.w a1,@r5+
                        movx.w a0,@r5+

      rts
      nop
```